

## CONSERVATION OF POWER IN RADIOTELEPHONE USE

### Field of the Invention

This invention relates to conserving battery power on backlight in a portable hand-held radiotelephone.

### Background of the Invention

A conventional portable handheld radiotelephone (referred to as a "radiotelephone" herein) provides backlight, which may be generated by one or more light emitting diodes (referred to as "LEDs" herein), electro-luminescence (referred to as "EL" herein), or other light emitting electrical sources, illuminates a viewable area such as a liquid crystal display (referred to as a "LCD" herein) and a keypad. A user is still able to view the LCD and access the keypad without the aid of external light sources, even if the surrounding area is dark.

Among the electrical components in a conventional radiotelephone, the backlight consumes a major portion of the power. In order to reduce the battery power associated with backlight use, a radiotelephone often adapts a timer based backlight turn-on/turn-off control: the user has an option to choose one of the pre-determined timer settings provided as a feature with the radiotelephone so that, upon each key press, the backlight is turned on for a pre-determined time interval. However, this use of timer based backlight control does not adequately account for variation of the ambient light. The backlight with turn-on, which helps viewing and/or accessing the LCD and keypad more clearly when the ambient light is insufficient, but does not improve viewing and accessing when the ambient light is sufficient to permit viewing and accessing without use of another light source. The additional illumination provided by the backlight is often unnoticeable by the user

during the day time, resulting in unnecessary and non-beneficial use of the battery power. Presently available technology provides an option to choose to turn off the backlight in selected circumstances, resulting in a saving of battery power. However, this technology is often inconvenient and/or cumbersome for the user because it requires changing the settings repeatedly as the circumstances change.

What is needed is an approach that provides the backlight automatically, without changing its settings but only when it is needed, so that the corresponding battery power during the backlight turn-on can be further saved while it is not needed.

#### Summary of the Invention

It is a principal object of the present invention to save the battery power associated with the backlight by placing one of more types of light sensors in strategically selected locations in the radiotelephone. One or more light sensors can be located near by where the LCD and keypad are located at such that it can measure the amount of intensity of the surrounding light. Depending on the threshold setting in terms of its brightness or darkness, which can be pre-programmable by the user and/or the settings provided by the radiotelephone, the backlight can be automatically turned on and off without the user's intervention.

Further, backlight operation can provide relatively more battery power saving by pre-programming the backlight brightness with multiple settings, that correspond to the intensity of surrounding light. This configuration provides more optimized viewing and/or accessing of LCD and/or keypad with respect to brightness of the backlight while conserving more battery power without comprising other performance.

### Brief Description of the Drawings

Figure 1 is a schematic view of a radiotelephone configured to practice the invention.

Figure 2 is a flow chart of a procedure for practicing the invention.

Figures 3 and 4 illustrate graphically possible variations of backlight power supplied with certain ambient light intensities.

### Detailed Description of the Preferred Embodiments

Figure 1 is a perspective view of a radiotelephone 11 configured to practice the invention in one embodiment. A front side and/or a back side of the radiotelephone 11 includes LCD(s) 13, an LCD backlight 14, a keypad 15, a keypad backlight 16, an antenna 17, a speaker 21, a microphone 23, an ambient light intensity (ALI) sensor 25, a controller 27, including a microprocessor or computer, that receives and analyzes the sensed ALI, and an electrical power source 29 with a controllable load, connected to one or more of the backlights. In response to receipt of an ALI value from the sensor 25 and comparison of this ALI value with a reference value ALI(ref), the controller 27 adjusts the electrical power provided by the power source 29 for the backlight(s) 14 and/or 16. This power adjustment may be full-off or full-on or may vary monotonically with the difference,  $ALI(ref) - ALI$ , or with the ratio,  $ALI/ALI(ref)$ , using a present or recent-past ALI value. The reference value ALI(ref) may be varied by the user to accommodate the eye sensitivity or visual acuity of the user.

Figure 2 is a flow chart of a procedure for practicing the invention. In step 31, the system measures or receives ambient light intensity (ALI) for the radiotelephone. In step 33, the system determines if the ALI is at least as large as a reference value ALI(ref). If the answer to the query in step 33 is "yes,"

the system enters, or continues to reside in, a backlight sleep mode, in step 35, and returns to step 31. If the answer to the query in step 33 is “no,” the system determines if one or more of a selected group of radiotelephone functions is in use, in step 37. If the answer to the query in step 37 is “no,” the system enters, or continues to reside in, the backlight sleep mode, in step 35, and returns to step 31. If the answer to the query in step 37 is “yes,” the system turns on the backlight, using power up to a selected level, in step 39.

In step 41, the system initiates a timeout interval, in step 41, and begins accumulating time, in step 43. In step 45, the system determines if at least one of the selected group of radiotelephone functions continues to be used. If the answer to the query in step 45 is “yes,” the system returns to step 41 and initiates a new timeout interval. If the answer to the query in step 45 is “no,” the system determines if timeout has occurred (i.e., if the timeout interval has ended), in step 47. If the answer to the query in step 47 is “no,” the system returns to step 43 and continues to accumulate time. If the answer to the query in step 47 is “yes,” the system enters the backlight sleep mode, in step 35, and returns to step 31.

The selected level of backlight power provided by the system in step 39 may be an absolute value of power, such as fully-on. Alternatively, the selected level of backlight power provided may vary monotonically with one or more of the variables  $v1 = ALI(ref) - ALI$  and  $v2 = ALI/ALI(ref)$ . For example, as the variable  $v1$  decreases through positive values toward 0, illustrated in Figure 3, the ambient light intensity  $ALI$  is increasing toward the value,  $ALI(ref)$ , at which point the backlight is not needed for adequate illumination and/or display of alphanumeric and/or graphical information on a radiotelephone display screen. As the variable  $v2$  increases from 0 to 1, illustrated in Figure 4, the ambient light intensity  $ALI$  is (again) increasing

toward the value ALI(ref). As  $v_1$  decreases through positive values toward 0, and/or as  $v_2$  increases toward 1, the power provided for the backlight can be decreased monotonically, if not strictly monotonically, toward zero power.

Different radiotelephone users will have different eye sensitivities and/or visual acuities and may require different amounts of backlight to provide adequate illumination. The system allows a user to adjust the reference value ALI(ref), a selected power level provided for the backlight and other parameters according to the user's own requirements. Optionally, a radiotelephone may store the values of these adjustable parameters for one or more regular users of that radiotelephone so that, by entering a specialized keystroke sequence (e.g., a password) unique to that user, these parameters are automatically adjusted to their optimal values for that user. A set of one or more default parameters is optionally stored in the radiotelephone for users who have no special vision characteristics or requirements.